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(54) Respirator for use in a toxic environment

(57) A respirator comprising a face enveloping rigid visor 10 recessed to accommodate a breathing mask 11, a face seal 11a, detachably mounted on the edge of the visor and a skirt-cum-mounting assembly, 20, also mounted on the edge of the visor. The mask is arranged to direct incoming breathing air onto the visor optical portion, 10a, for demisting and personal comfort purposes and to collect it and pass it to the user.

Fig.2.

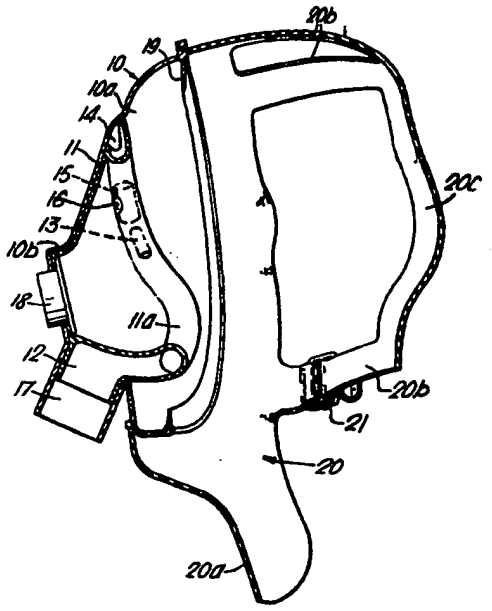

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Fig. 1.

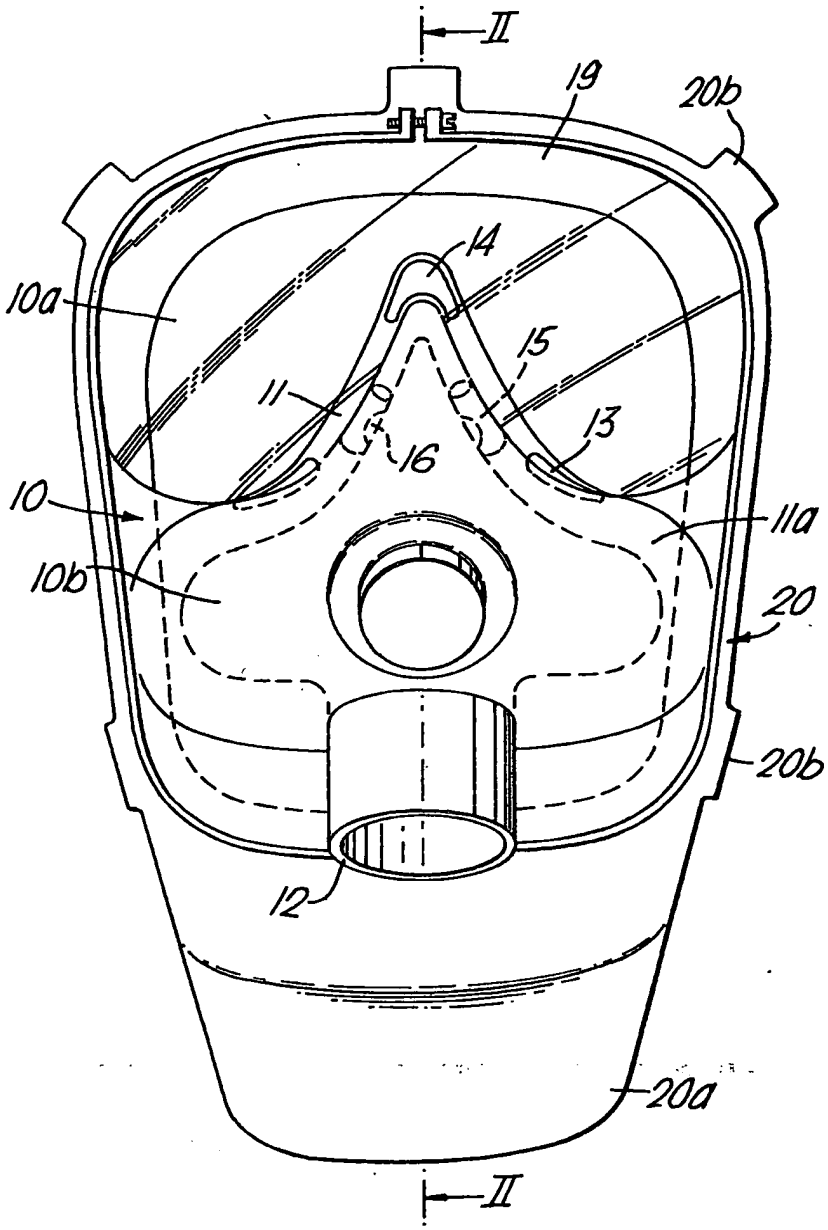
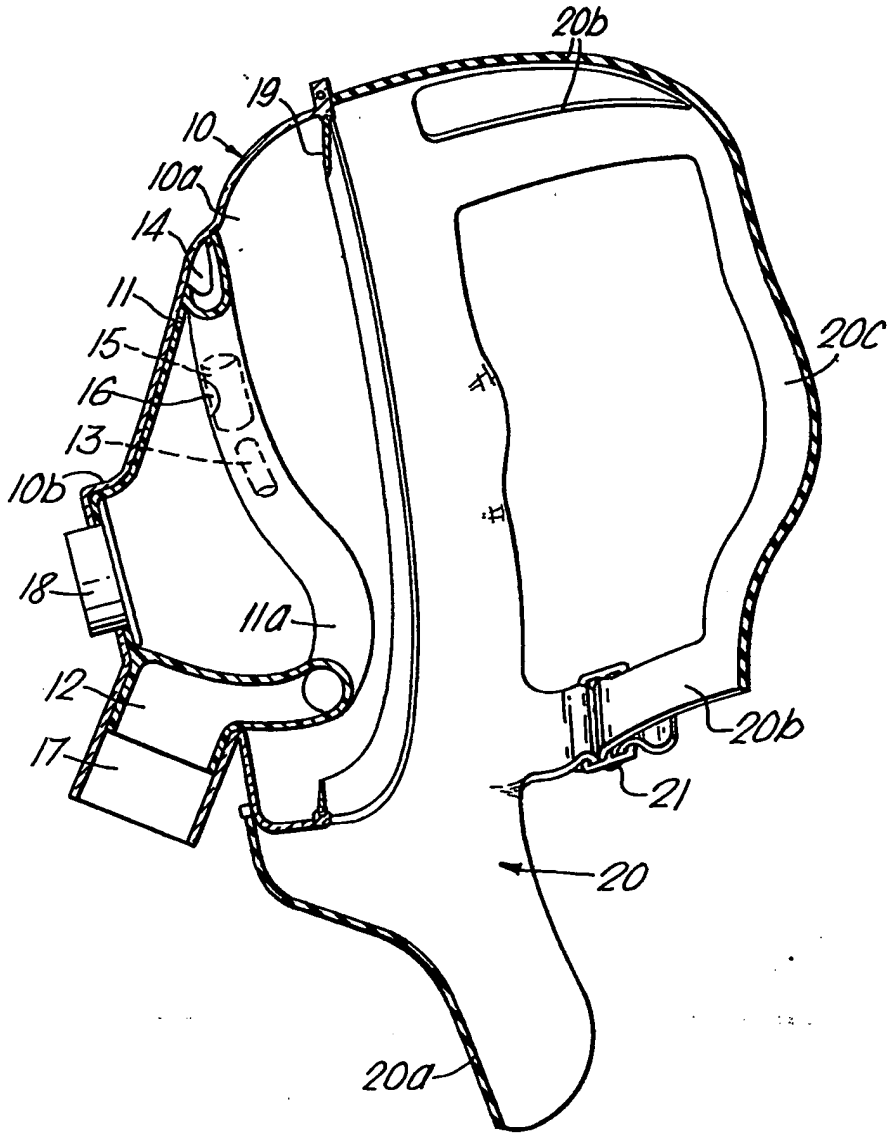


Fig. 2.



SPECIFICATION

Improvements in or relating to respirators

The present invention relates to respirators, that is devices for supplying personnel with respiratory gas. It is particularly concerned with a respirator for protecting the person and his breathing system from an unpleasant or toxic environment, especially in an industrial context.

According to the present invention a respirator for protecting the face and breathing from a toxic environment, comprises,

a visor of substantially rigid construction and adapted to cover substantially the whole face of a user, the visor having a transparent optical portion adapted to cover the eyes of a user and a breathing mask covering portion which is recessed internally to accommodate breathing mask means,

mask means associated with the mask carrying portion and arranged in use to impinge on the user's face and thereby to define a respiratory capacitance distinct from the general space within the respirator,

a duct adapted for connection to a supply of respiratory gas, and arranged to direct the gas onto the interior of the transparent optical portion,

a duct for carrying respiratory gas from the visor interior to the mask interior,

a non-return expiratory valve for exhausting exhalate from the mask to the visor exterior,

seal means approximate the edge of the visor for sealing the visor to the face of a user, and

respirator retaining means for retaining the respirator to the face of a user.

The respirator may also have a skirt member attached to the visor and covering the head sides, top and neck front of a user to provide a supplementary seal against the ingress of toxic substances to the respirator interior. The skirt member may be made of natural or synthetic rubber of the butyl, neoprene or silicone types, alone or in composite, perhaps fabric reinforced. It may be 1–3 mm thick and have a degree of resilience and be arranged for impinging, in use, upon the skin of the user.

The seal means may comprise a cushion member, filled with a gas or made or filled with a resilient material, a suitable filler being a polyurethane foam. It may alternatively comprise a reflected edge of elastic ot semi rigid plastics material seal. Preferably however it comprises a membrane of non rigid plastics material, normally extending inward from the visor. In any case it is preferably detachable from the visor for maintenance and replacement purposes. The seal means may employ natural or synthetic rubber of the butyl, neoprene or silicone types as the skin/cushion interface, alone or in composite, whatever form the seal means takes. The rubber may be 0.1–0.5 mm thick. If moulded as a tapered feather edge it could be up to 2 mm thick at the taper base.

The visor may comprise a polymethyl methacrylate, nylon, polycarbonate or polyurethane, and may be 0.5–2.5 mm, preferably 1.5–2.0 mm thick. Thus it is preferably an integral structure as distinct from a composite. It may be formed in a powder injection or vacuum moulding process. To minimise scratching of the visual portion this may be coated with an abrasion resistant compound of, for example, silicone. The recess formed therein to carry the mask means can be arranged to assist in maintaining the rigidity of the visor while at the same time permitting it, apart from the recess therein, to occupy a position quite close to the user's face, ie within 1–3 cm thereof on average.

The optical portion of the visor is preferably formed as part of a sphere. The remainder of the visor, including the mask carrying portion, may be rendered opaque, for example with matt black paint, to prevent stray light entering the front of the respirator and perhaps causing undesirable reflections. The visor may be arranged to permit a user to wear spectacles or it may carry a mount for spectacle lenses.

The combination of extent, integrity, three dimensional structure and rigidity in visors in a preferred embodiment of the invention has several important advantages. The optical properties of the optical portion remain substantially constant and problems at the interface of visor and certain sighting devices which the wearer may have to use are minimised. The visor can remain substantially unaffected by the weight or oscillations of any flexible feed tubes and provide a reliable substrate or datum for the operation of any respirator mounted controls or components—even to some extent if these are actually mounted on the visor. It provides a safe substrate for the penetration of the respirator by the various services thereto and for mounting various other items of equipment.

The visor may be moulded to suit a particular user. However it is believed that quite a small number of different visor sizes are all that would be required to suit the range of user face sizes.

The respirator retaining means preferably comprises an elasticated cradle, which may have adjustment means.

The breathing mask means may comprise an oro-nasal mask attached to the visor perhaps by means permitting positional adjustment thereof within the visor. Alternatively it may be constituted by walling projecting inwardly from the visor at a location such as will, in use, surround the user's nose and, preferably, mouth.

If the mask is shaped to contact the wear-

er's face across the bridge of the nose and in the region of the cheek bones the ducts by which respiratory gas is directed over the visor optical portion may be formed in the mask member walling with orifices therefrom immediately below where in use the eyes of the wearer will lie. The duct for conveying the gas to the interior of the mask member may pass through the mask walling in the region of the bridge of the nose. The mask member may also carry a microphone or speech diaphragm of the type well known in the respirator art. The expiratory valve may be part of a speech diaphragm assembly, and preferably embodies two valves in series with a dead space therebetween to ensure back leaking does not occur. An inlet non-return valve may be sited in the duct for carrying gas from the visor interior to the mask interior.

Breathing air is preferably arranged to be supplied from a positive pressure source, eg a compressed air bottle or filter blower unit, to reduce the risk of seepage into the respirator cavity past the seal means. It is however an advantage of the minimised air space afforded by the invention that it is suitable for use in a normal demand breathing situation when the filter may be mounted on the visor or body mounted.

In addition to preventing misting or frosting of the internal surface of the optical portion the arrangement for directing breathing gas firstly into the visor, as distinct from the mask cavity, can have the effect of reducing subject discomfort which might otherwise result from wearing such a respirator in a warm environment of a physical exertion context. The closer the visor is arranged to be to the user's face, provided there is an air gap, the greater will be the demisting and comforting effects of a unit volume flow of gas.

The respirator in accordance with the present invention will now be described, by way of example, with reference to the accompanying drawings, of which:

Figure 1 is a front elevation of the respirator, and

Figure 2 is a view on II–II in Fig. 1.

As shown in the drawings the respirator has a visor 10 adapted to cover the face of a user. It is a substantially rigid integral moulding in a transparent plastics material and comprises a optical portion 10a and a breathing mask carrying portion 10b. The portion 10b is recessed to carry on oronasal breathing mask 11.

The mask 11 is made of a resilient plastics material and has a tubular face seal 11a. The lower interior of the seal 11a communicates with an respiratory inlet 12 formed in the visor 10 and has exit slots 13 in an upper cheek region. The upper interior of the seal 11a communicates with the visor interior via an inlet 14. Divider units 15 situated over exits 16 from the seal 11a interior into the mask cavity serve to partition the seal upper from the seal lower interiors. The inlet 12 contains a non-return valve 17. The interior of the mask 11 communicates with the exterior of the respirator via a speech diaphragm-cum-expiratory non-return valve 18 assembly mounted, with the mask, on the visor 10. The assembly 18 embodies two non-return valves in series, with a dead space therebetween.

A visor seal 19 is detachably mounted on the edge of the visor 10. It comprises a non-rigid membrane extending inward from the visor and is so shaped and dimensioned as to bear against the face when the mask seal 11a does so.

A skirt-cum-anchorage member 20 is also detachably mounted at the edge of the visor to form a supplementary seal. The skirt is a composite of butyl and neoprene rubbers and is formed with a neck shield 20a, anchorage straps 20b and a back pad 20c. The lower of the straps 20b are adjustable via buckles 21.

The respirator is donned with the buckles 21 undone or loosened, by the user inserting his face into the visor 10 until the mask 11 and the membrane 19 seals against it. The buckles 21 are then fastened. The inlet 12 is connected to a source of clean breathing air, ie either a filter which may be mounted thereon or a blower filter unit or gas bottle. When the user breathes in gas entering via the inlet 12 passes through the mask lower seal 11a and is directed onto the visual portion 10a by the slots 13. It is collected from the visor interior at the orifice 14 and passes via the units 15 at holes 16 into the mask interior. Upon expiration exhalate leaves the respirator via the assembly 18.

It will be appreciated that the above embodiment has been described by way of example only. Other embodiments, still within the scope of the invention, will occur to those skilled in the rest. For example the mask may have a simple reflected edge seal for sealing to the user's face while the ducting for the respiratory air may be formed or carried on its outer surface.

CLAIMS

1. A respirator for protecting the face and breathing from a toxic environment, comprising

a visor of substantially rigid construction and adapted to cover substantially the whole face of a user, the visor having a transparent optical portion adapted to cover the eyes of a user and a breathing mask covering portion which is recessed internally to accommodate breathing mask means,

mask means associated with the mask carrying portion and arranged in use to impinage on the user's face and thereby to define a respiratory capacitance distinct from the general space within the respirator,

a duct adapted for connection to a supply

of respiratory gas, and arranged to direct the gas onto the interior of the transparent optical portion,

a duct for carrying respiratory gas from the visor interior to the mask interior,

a non-return expiratory valve for exhausting exhalate from the mask to the visor exterior,

seal means approximate the edge of the visor for sealing the visor to the face of a user, and

respirator retaining means for retaining the respirator to the face of a user.

2. A respirator as claimed in claim 1 and also having a skirt member attached to the visor and covering the head sides, top and neck front of a user to provide a supplementary seal against the ingress of toxic substances to the respirator interior.

3. A respirator as claimed in claim 2 and wherein the skirt member is made of natural or synthetic rubber of the butyl, neoprene or silicone types, alone or in composite.

4. A respirator as claimed in claim 2 or claim 3 and 1–3 mm thick.

5. A respirator as claimed in any one of claims 2 to 4 and wherein the skirt has a degree of resilience.

6. A respirator as claimed in any one of claims 2 to 5 and wherein the skirt is arranged for impinging, in use, upon the skin of the user.

7. A respirator as claimed in any one of the preceding claims and wherein the seal means comprises a cushion member, filled with a gas or made or filled with a resilient material.

8. A respirator as claimed in claim 7 and wherein the said resilient material is a polyurethane foam.

9. A respirator as claimed in any one of claims 1 to 6 and wherein the seal means comprises a reflected edge of elastic or semi rigid plastics material.

10. A respirator as claimed in any one of claims 1 to 6 and wherein the seal means comprises a membrane of non rigid plastics material, normally extending inward from the visor.

11. A respirator as claimed in any one of the preceding claims and wherein the seal means is detachable from the visor.

12. A respirator as claimed in any one of the preceding claims and wherein the visor is coated with an abrasion resistant compound.

13. A respirator as claimed in any one of the preceding claims and wherein the optical portion of the visor is formed as part of a sphere.

14. A respirator as claimed in any one of the preceding claims and wherein the non optical portion of the visor is rendered opaque.

15. A respirator as claimed in any one of the preceding claims and wherein the visor carries a mount for spectacle lenses.

16. A respirator as claimed in any one of the preceding claims and wherein the retaining means comprises an elasticated cradle.

17. A respirator as claimed in any one of the preceding claims and wherein the breathing mask means comprises an oro-nasal mask attached to the visor.

18. A respirator as claimed in any one of the preceding claims and wherein the breathing mask means is constituted by walling projecting inwardly from the visor at a location such as will, in use, surround the user's nose and mouth.

19. A respirator as claimed in any one of the preceding claims and wherein the breathing mask means is shaped to contact the wearer's face across the bridge of the nose and in the region of the cheek bones and the ducts by which respiratory gas is directed over the visor optical portion are formed in the mask member walling with orifices therefrom immediately below where in use the eyes of the wearer will lie.

20. A respirator as claimed in claim 19 and wherein the duct for conveying the gas to the interior of the mask member passes through the mask walling in the region of the bridge of the nose.

21. A respirator as claimed in any one of the preceding claims and wherein the expiratory valve is part of a speech diaphragm assembly.

22. A respirator as claimed in any one of the preceding claims and wherein the expiratory valve embodies two valves in series with a dead space therebetween to ensure back leaking does not occur.

23. respirator as claimed in any one of the preceding claims and having an inlet non-return valve sited in the duct for carrying gas from the visor interior to the mask interior.

24. A respirator substantially as hereinbefore described with reference to the accompanying drawings.

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